

Analysis of optical spectra of V1357 Cyg≡Cyg X-1

Shimanskii V., Karitskaya E., Bochkarev N., Galazutdinov G., Lyuty V., Shimanskaya N.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Optical spectra and light curves of the massive X-ray binary V1357 Cyg are analyzed. The calculations were based on models of irradiated plane-parallel stellar atmospheres, taking into account reflection of the X-ray radiation, asphericity of the stellar surface, and deviations from LTE for several ions. Comparison of observed spectra obtained in 2004-2005 at the Bohyunsan Observatory (South Korea) revealed variations of the depths of H I lines by up to 18% and of He I and heavy elements lines by up to 10%. These variations are not related to the orbital motion of the star, and are probably due to variations of the stellar wind intensity. Perturbations of the thermal structure of the atmosphere due to irradiation in various states of Cyg X-1 (including outburst) do not lead to the formation of a hot photosphere with an electron temperature exceeding the effective temperature. As a result, variations of the profiles of optical lines of H I, He I, and heavy elements due to the orbital motion of the star and variations of the irradiating X-ray flux do not exceed 1% of the residual intensities. Allowing for deviations from LTE enhances the H I and He I lines by factors of two to three and the Mg II lines by a factor of nine, and is therefore required for a fully adequate analysis of the observational data. Analysis of the H I, He I, and He II lines profiles yielded the following set of parameters for the O star at the observing epoch: $T_{\text{eff}} = 30\,500 \pm 500$ K, $\log g = 3.31 \pm 0.05$, $[\text{He}/\text{H}] = 0.42 \pm 0.05$. The observed He I line profiles have emission components that are formed in the stellar wind and increase with the line intensity. The abundances of 11 elements in the atmospheres of V1357 Cyg and α Cam, which has a similar spectral type and luminosity class, are derived. The chemical composition of V1357 Cyg is characterized by a strong excess of helium, nitrogen, neon, and silicon, which is related to the binarity of the system. © 2012 Pleiades Publishing, Ltd.

<http://dx.doi.org/10.1134/S106377291210006X>
